# *New Analyses of the Moon's North Polar Illumination Conditions*

**Ben Bussey**
**Angela Stickle**
**Andy McGovern**
***Space Department JHU/APL***

**Paul Spudis**
***LPI***



JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

# LunarShader Results


- Post the recent armada of international missions, we now have topography and image data with sufficient fidelity to fully characterize the polar illumination conditions
  - Maximum single period of illumination
  - Determine all eclipse periods
  - Exact shadow locations
  - Effect of mast height
  - Communications
- For this study a 30 m DEM was used with a 1 hour cadence

Image courtesy of Tony Colaprete



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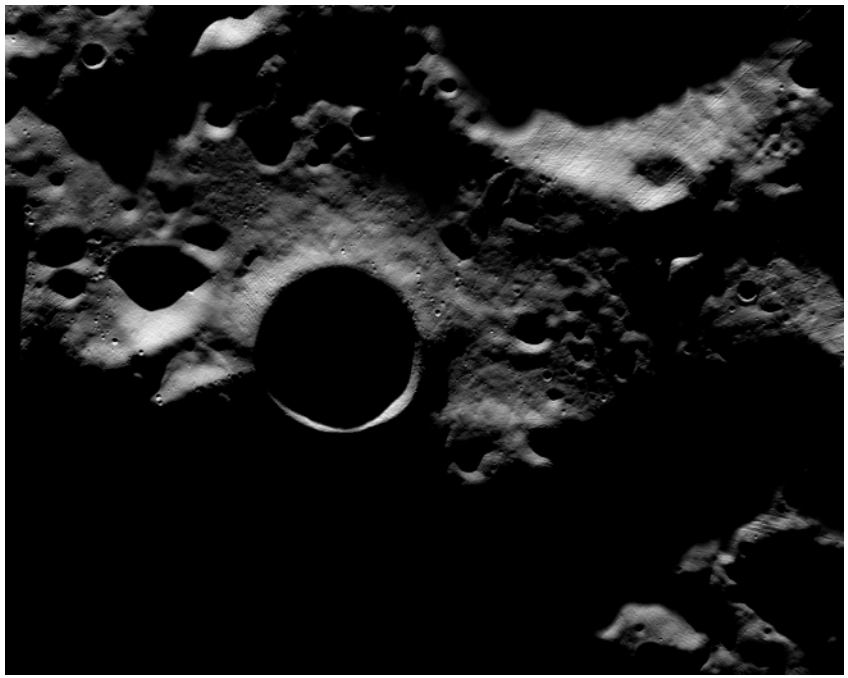
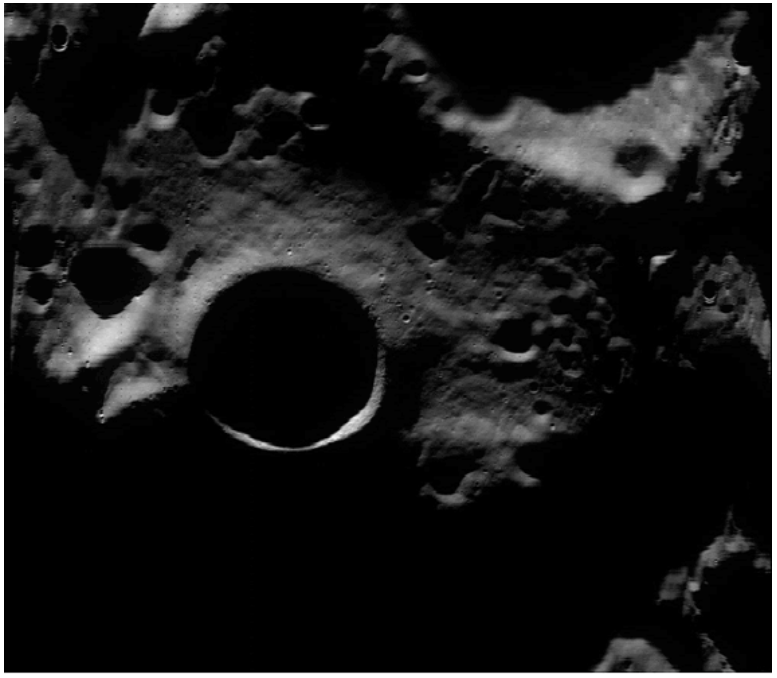
# LROC / Simulation Comparison

- One is generated from a 100 m LOLA grid and the other is an LROC image
- LOLA-based image generated with ray traced extended source shadows plus Gaskell's fits to the McEwen Lunar-Lambert photometric function







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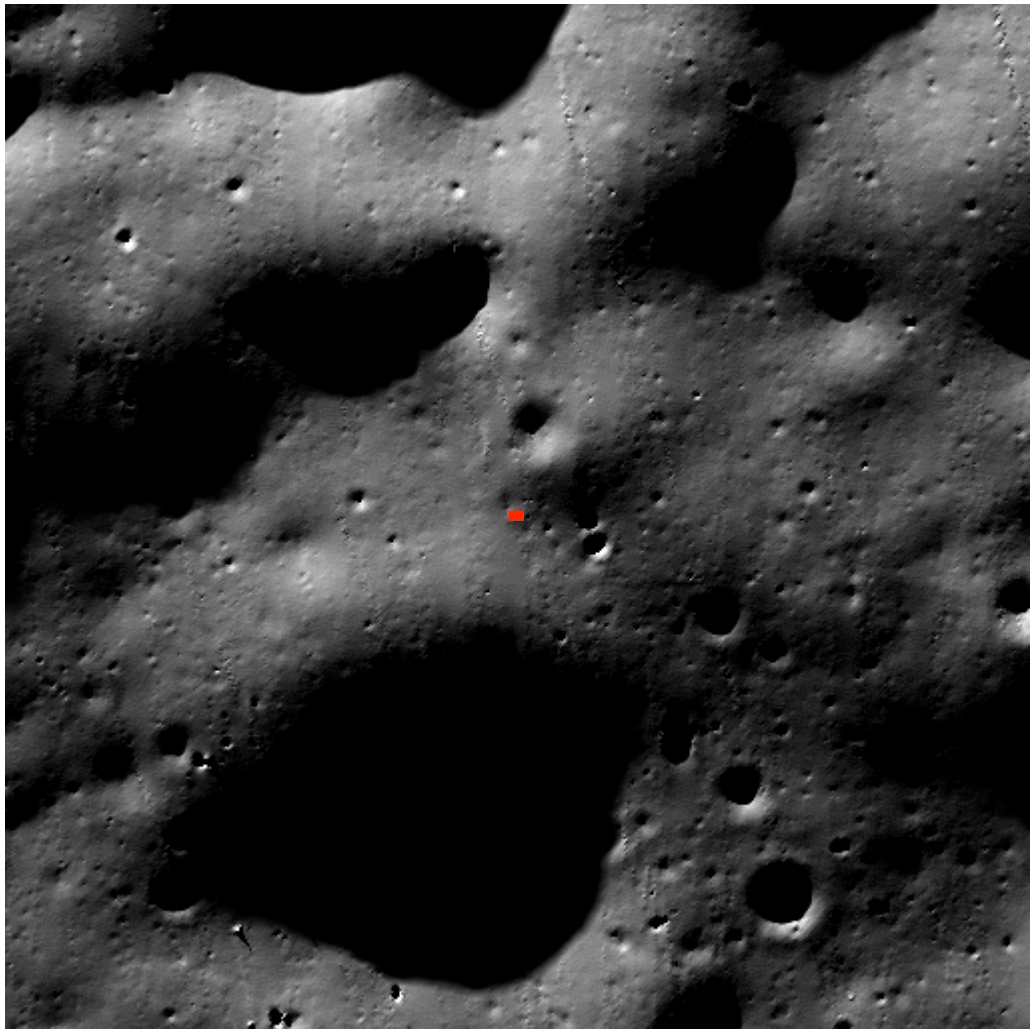
# LROC / Simulation Comparison



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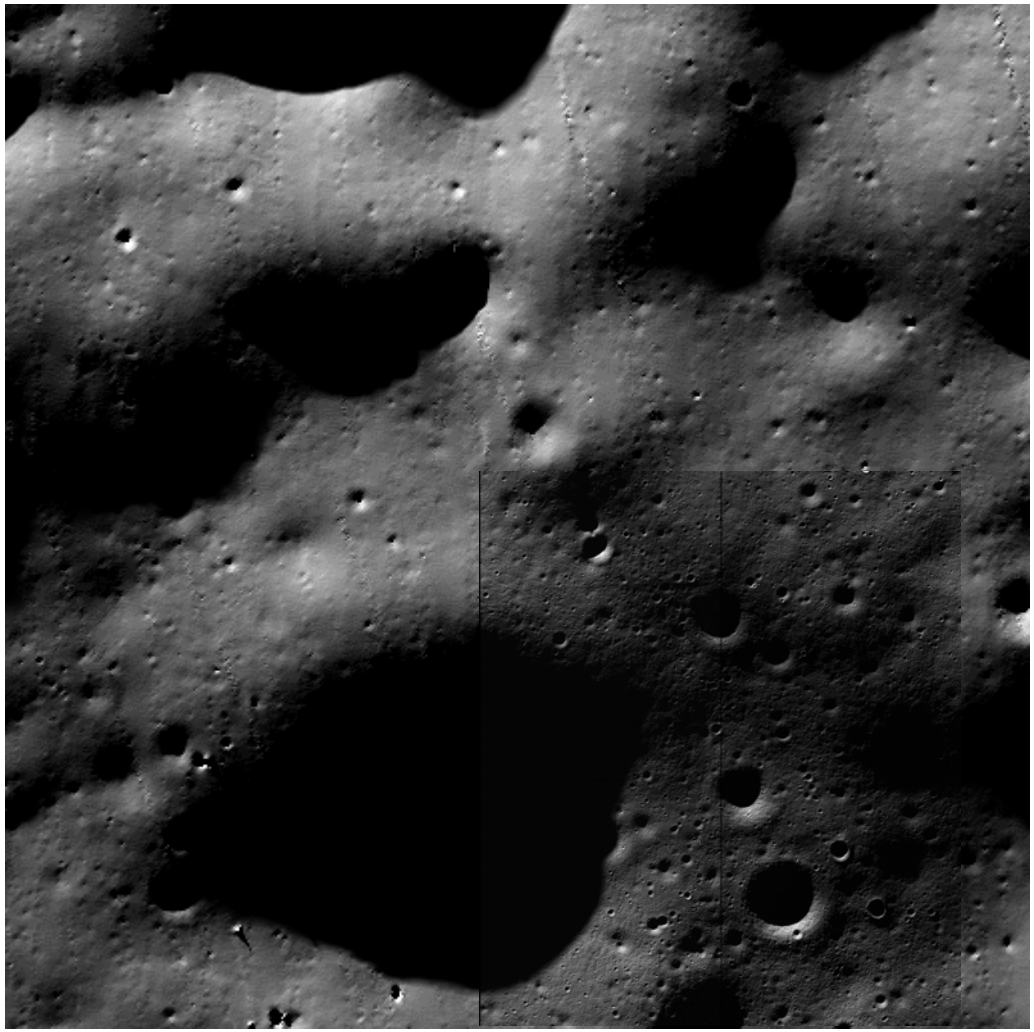



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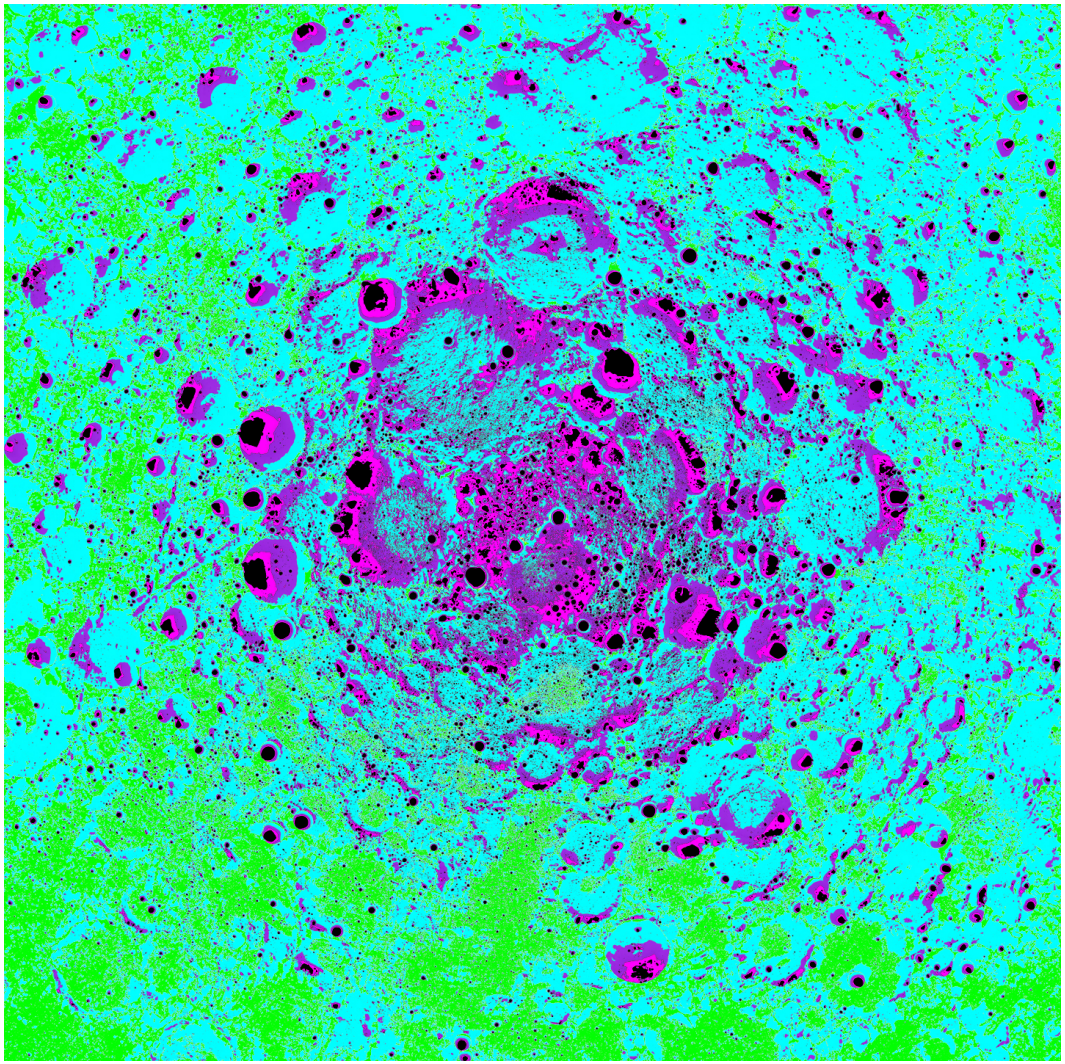
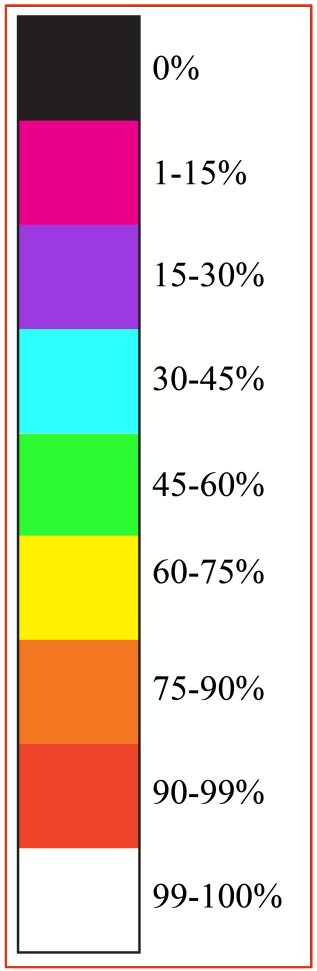
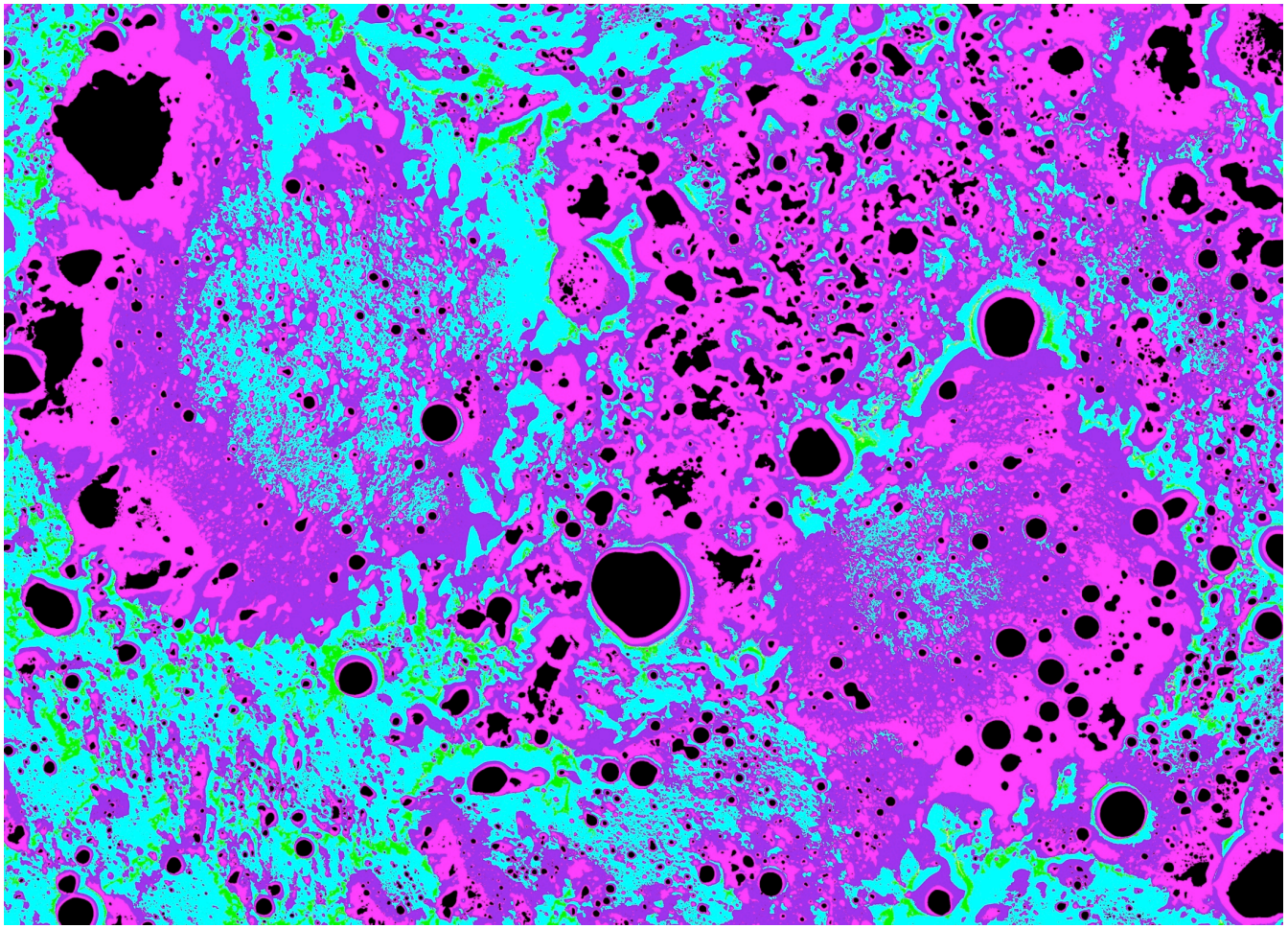
# NP 80° Movie

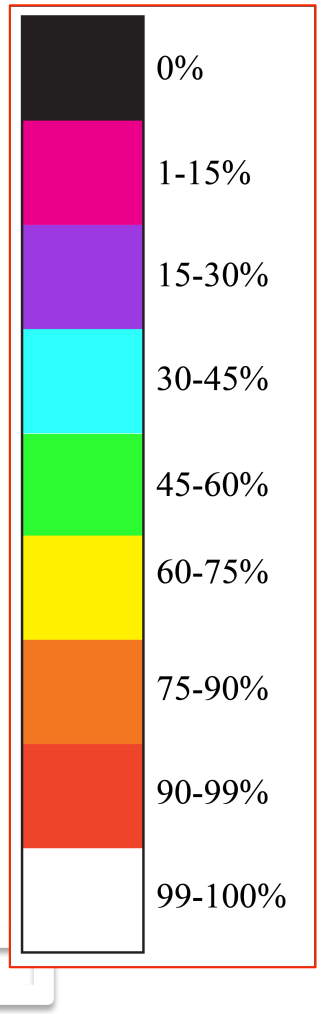
# North Pole @ 30m/pix





# Hermite & Peary





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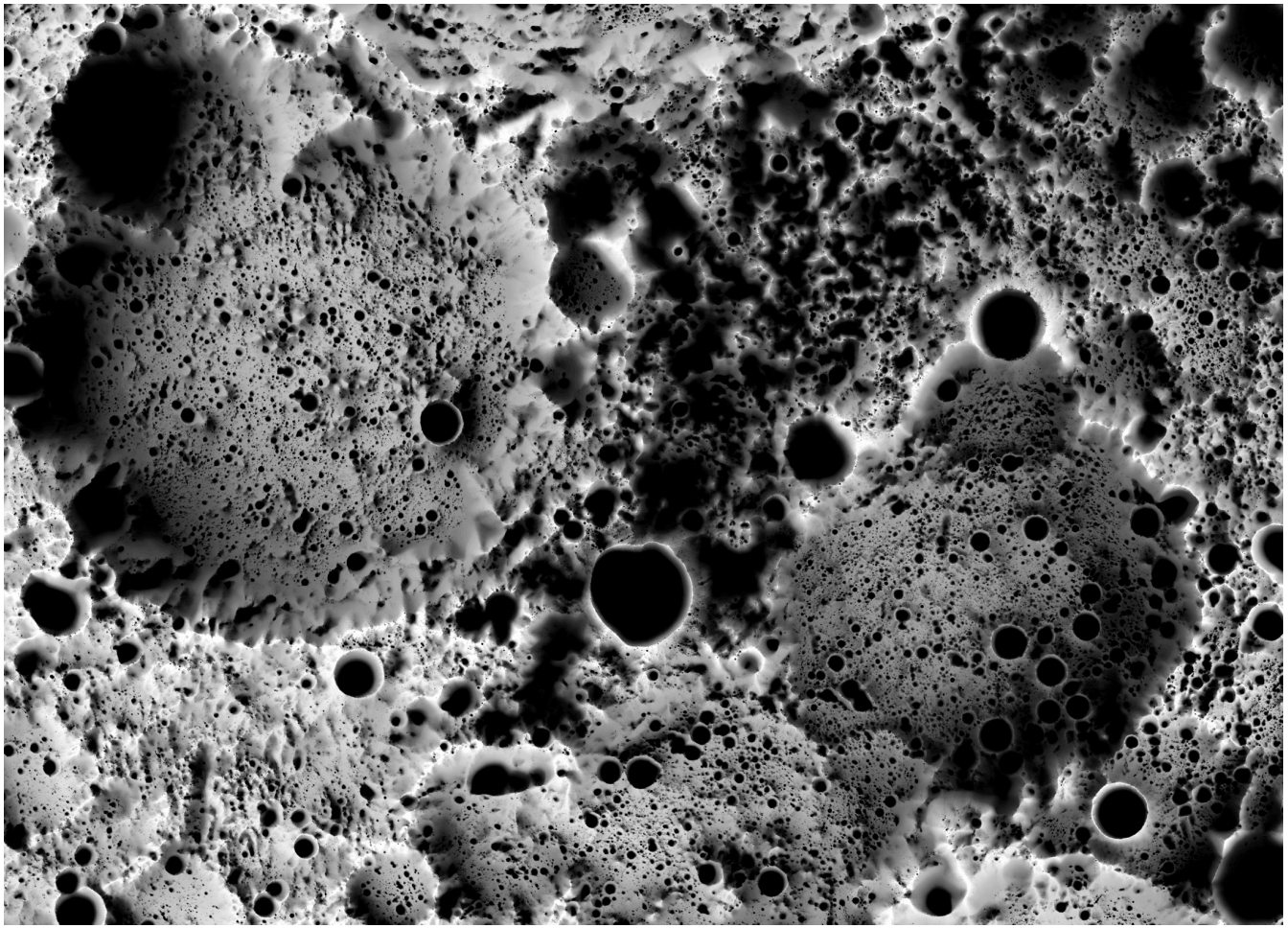

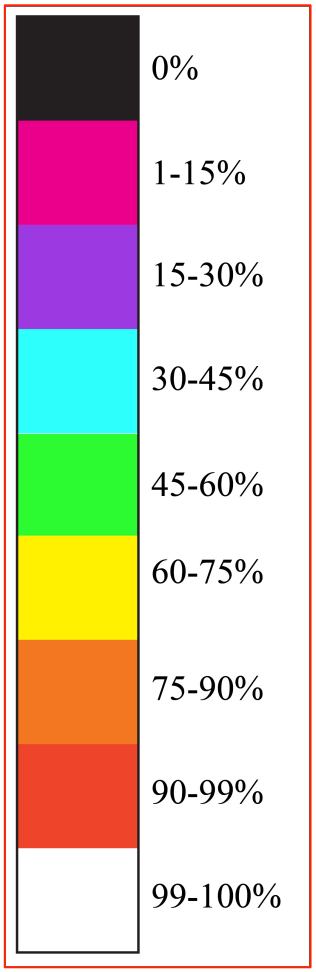




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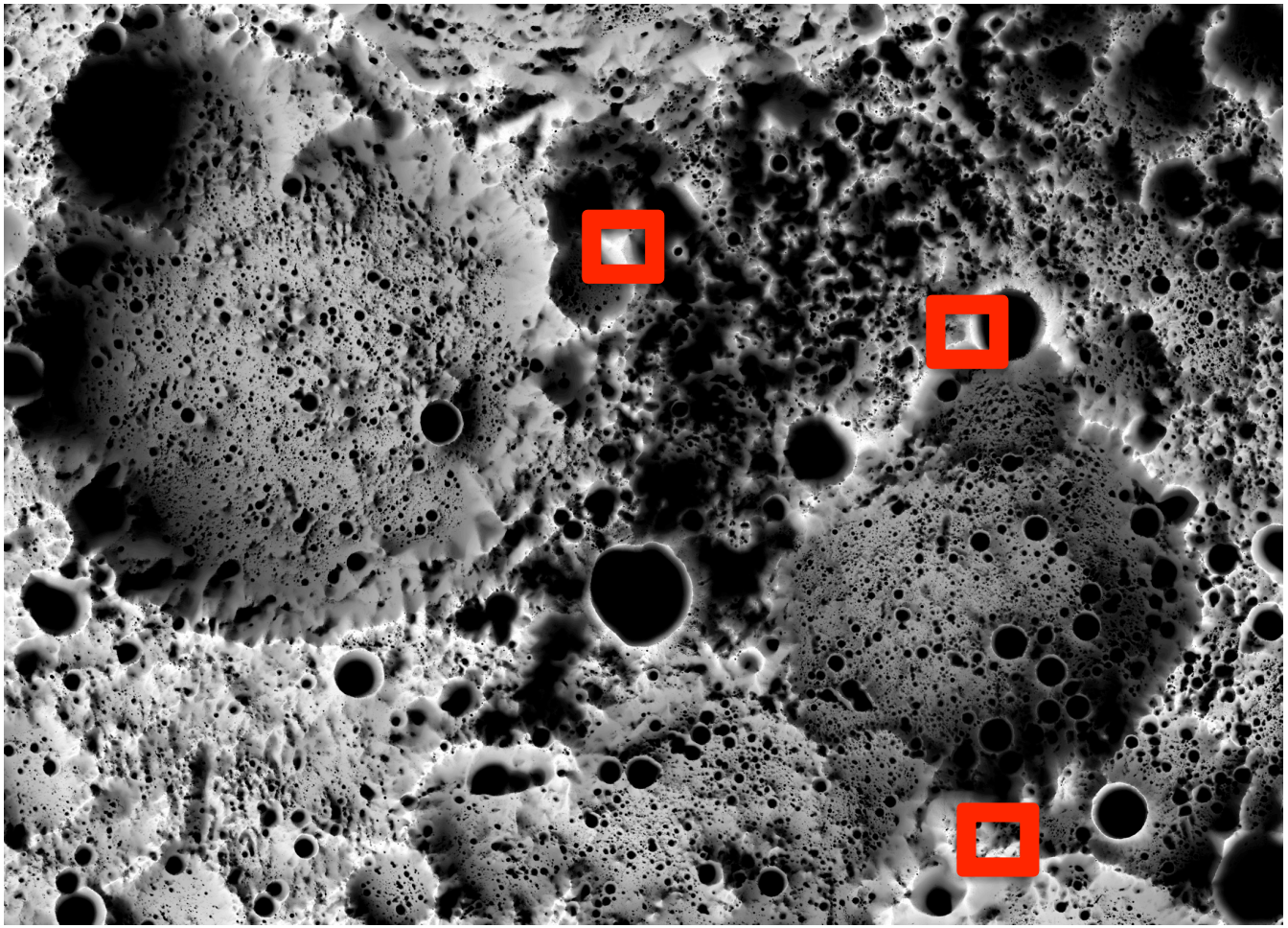
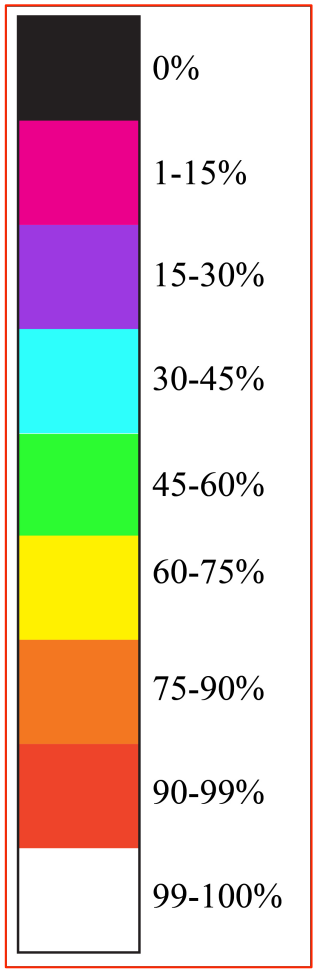
# Three Most Illuminated Sites





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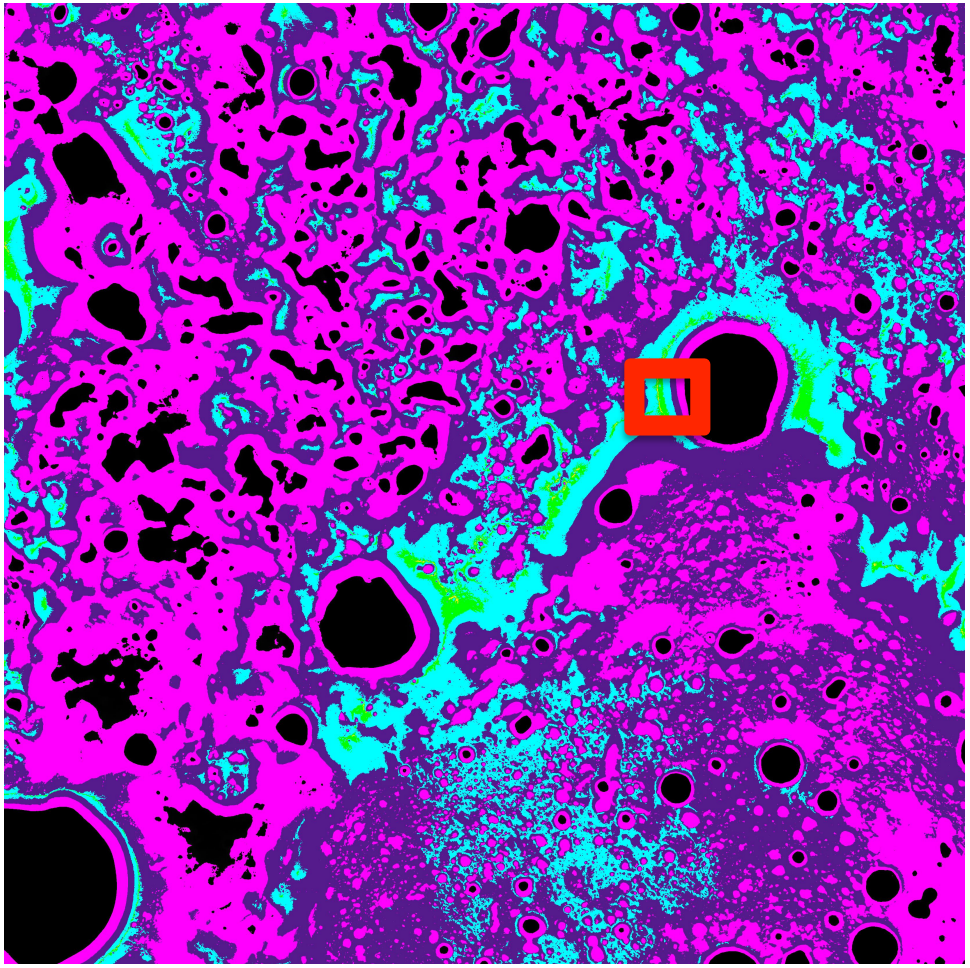
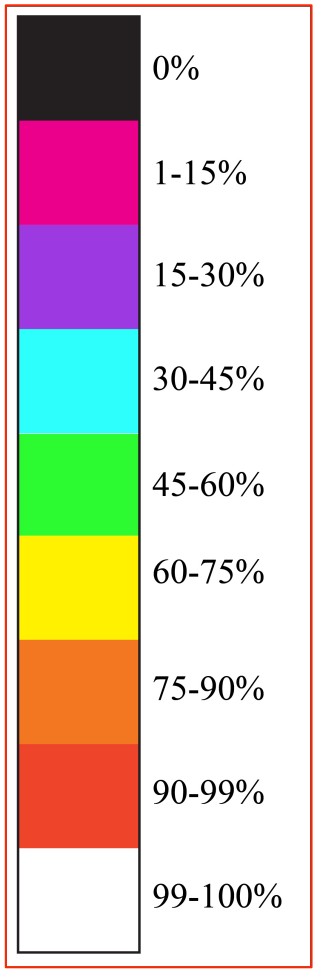
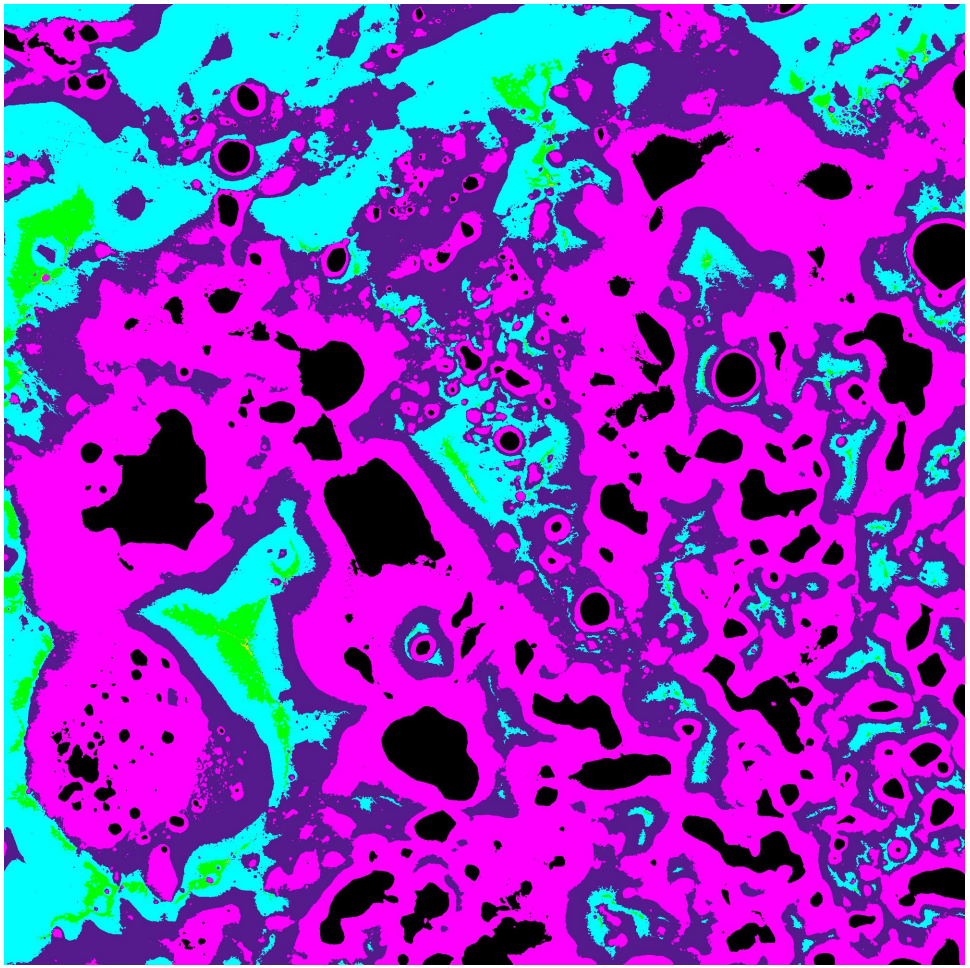
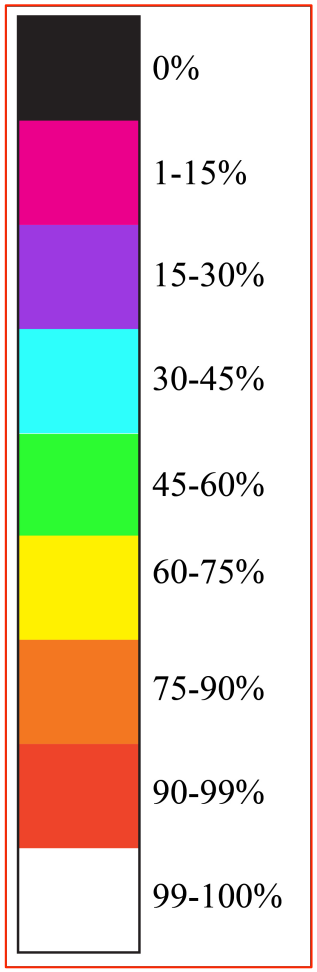
# Peary N





# Hermite





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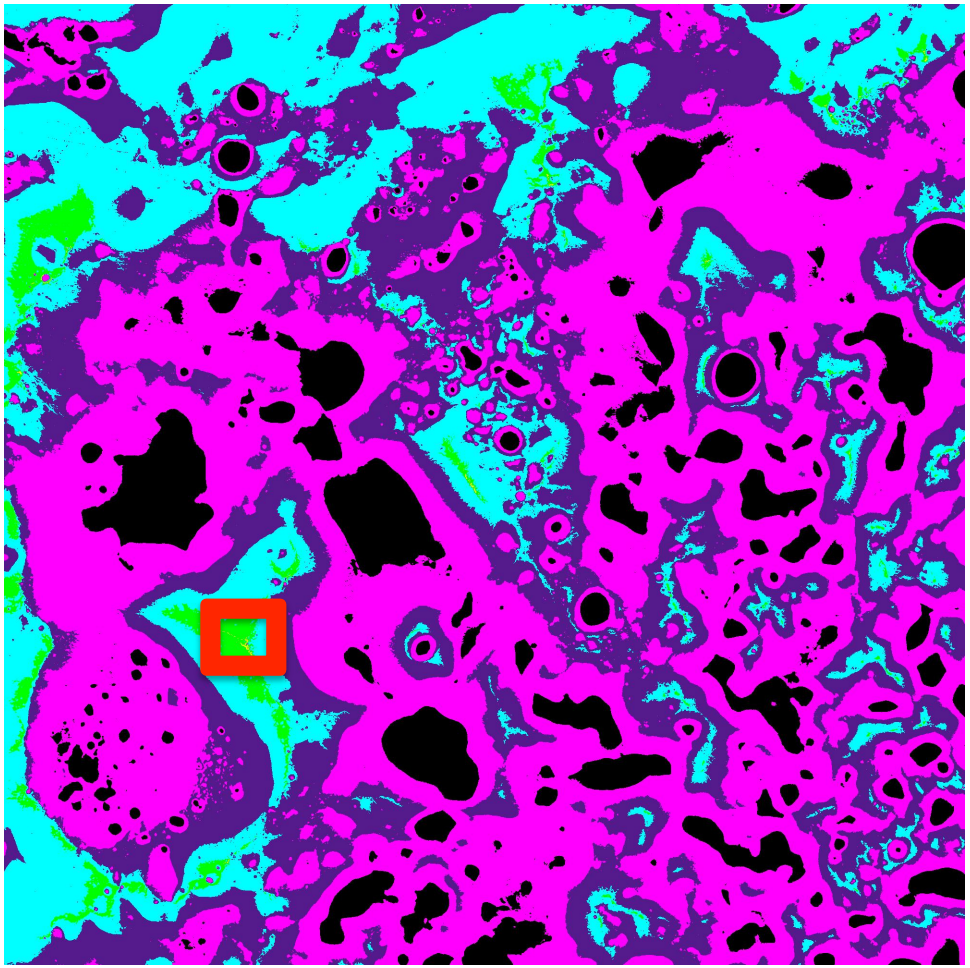

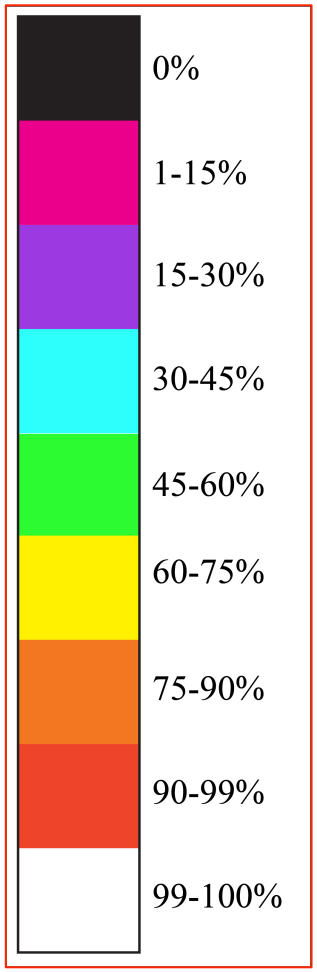




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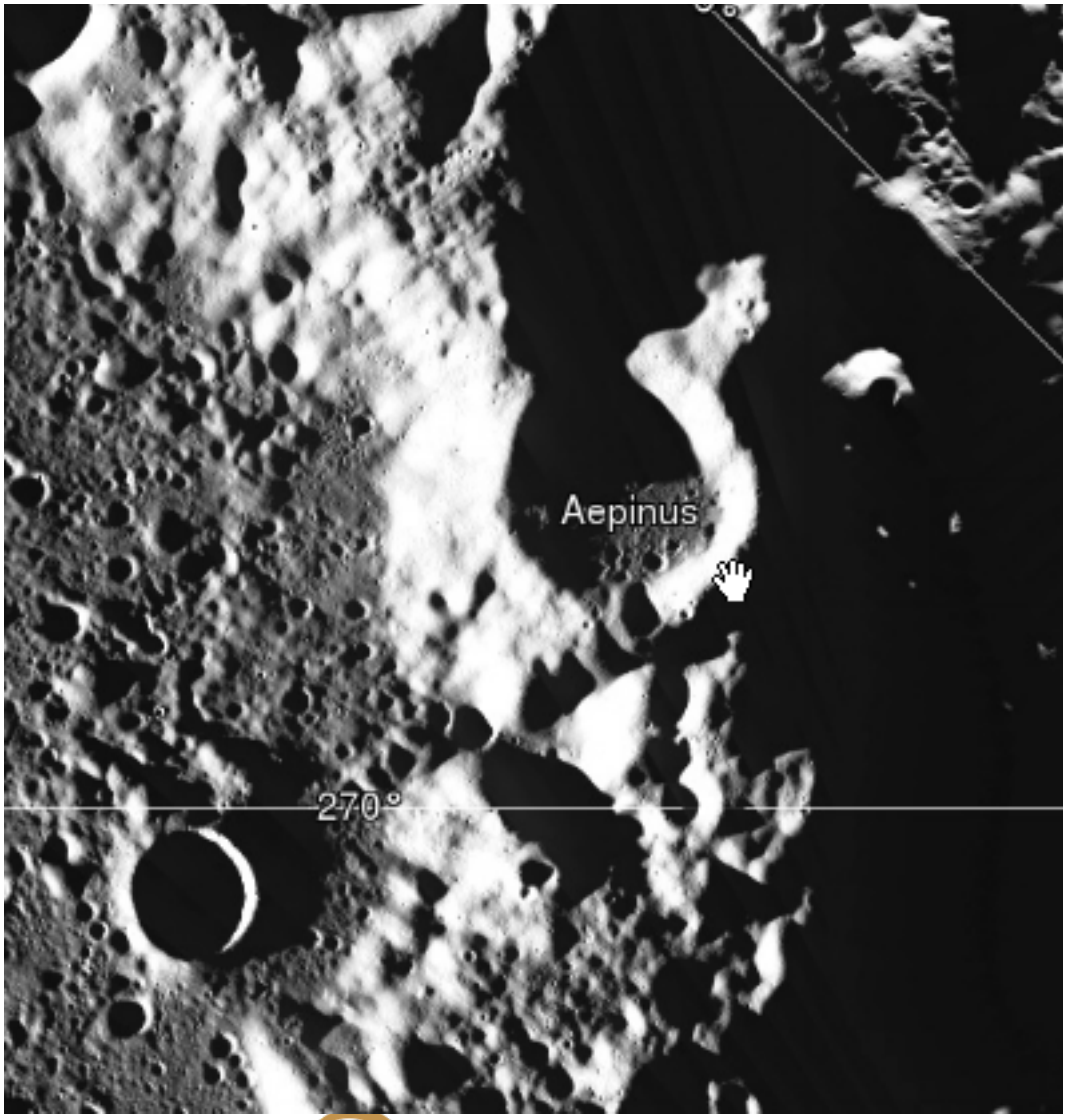
# http://lroc.sese.asu.edu/images/gigapan



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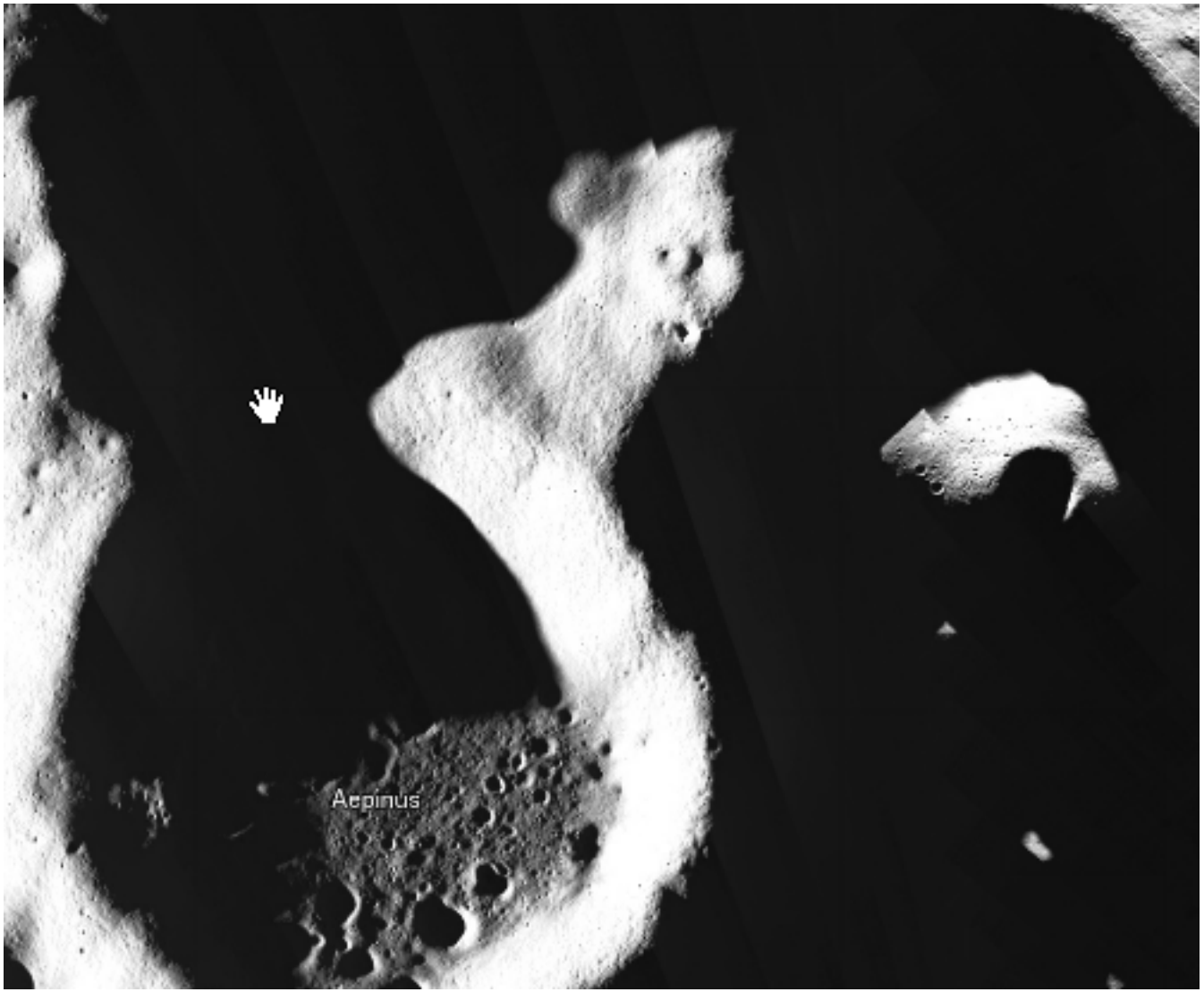




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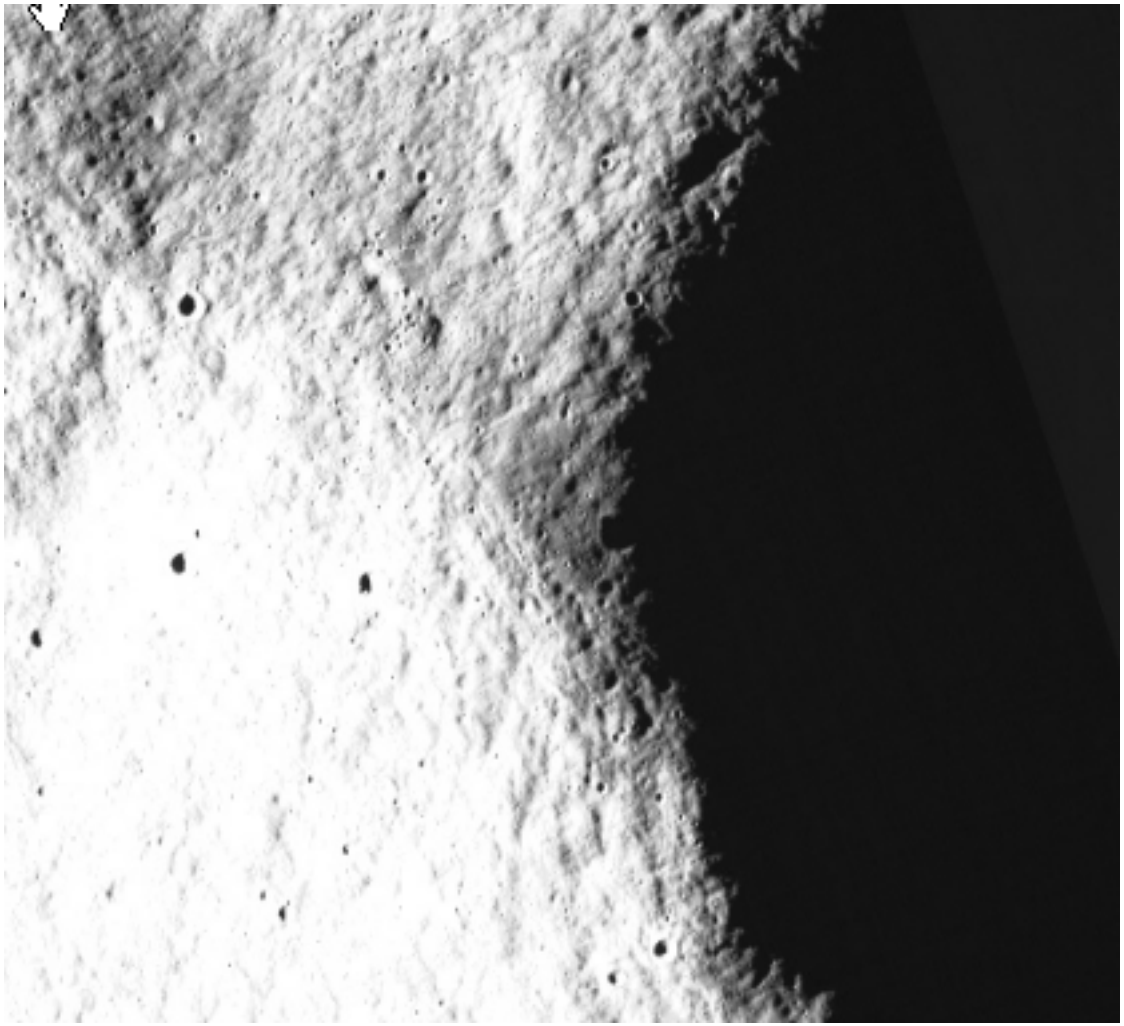



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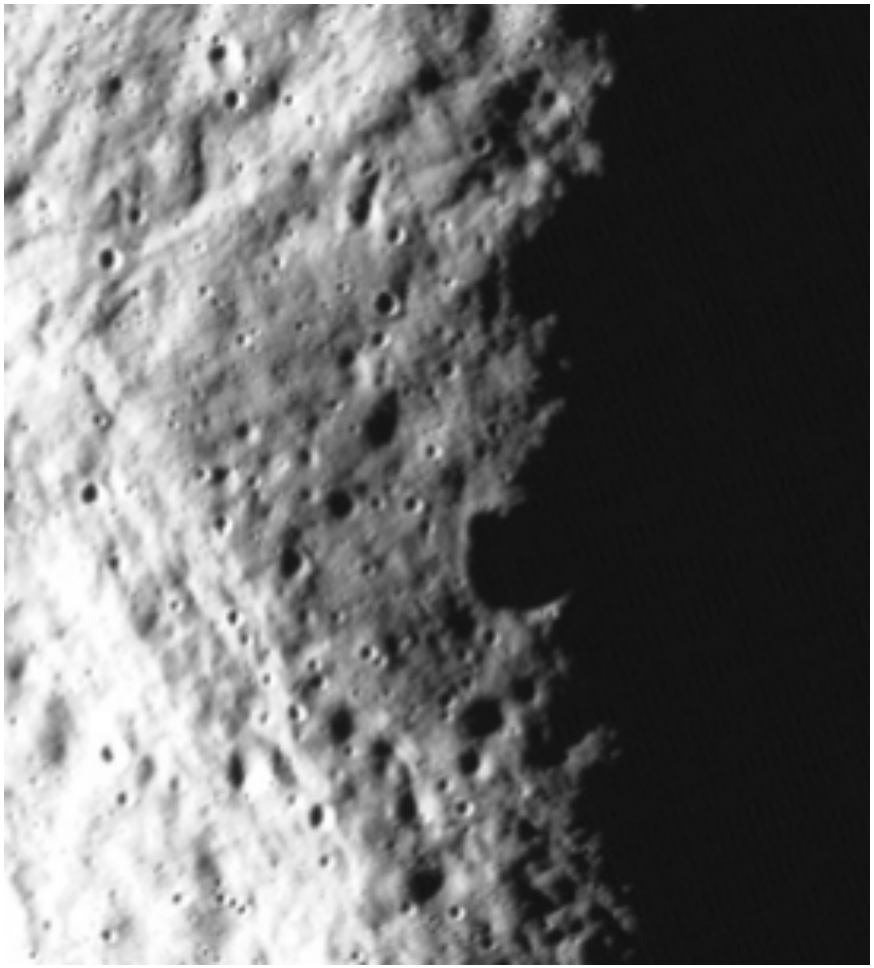



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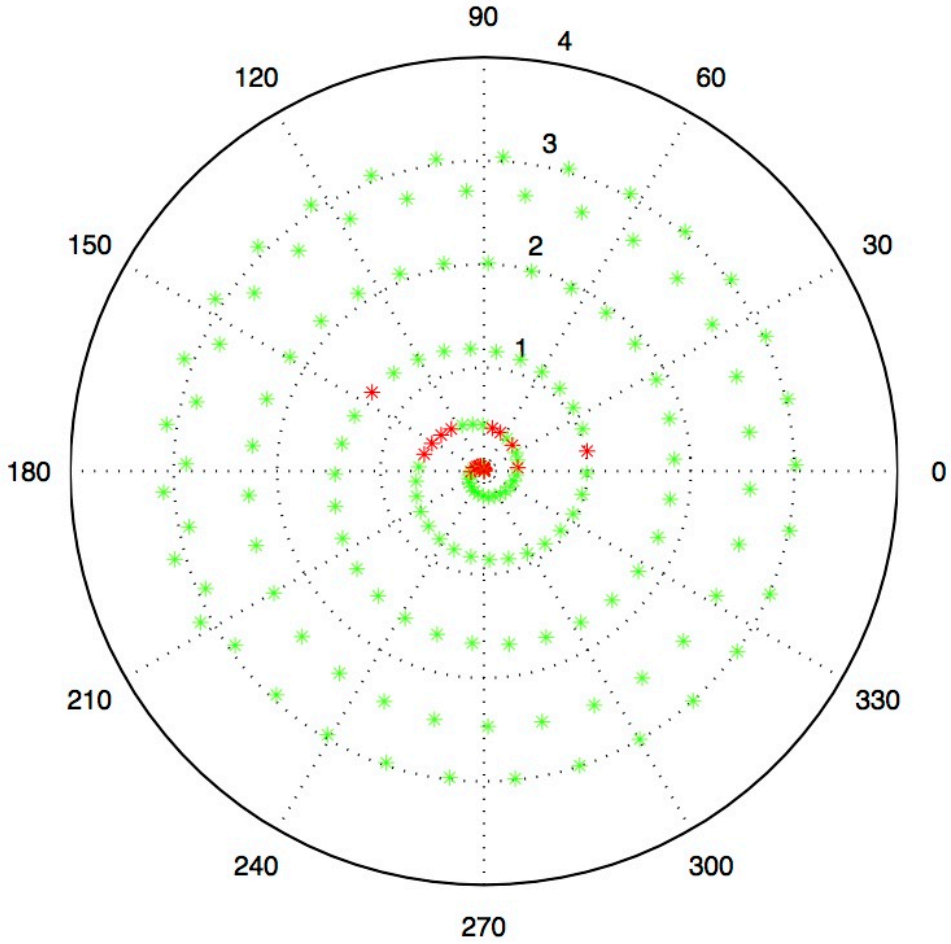
# Peary N Spiral Plot



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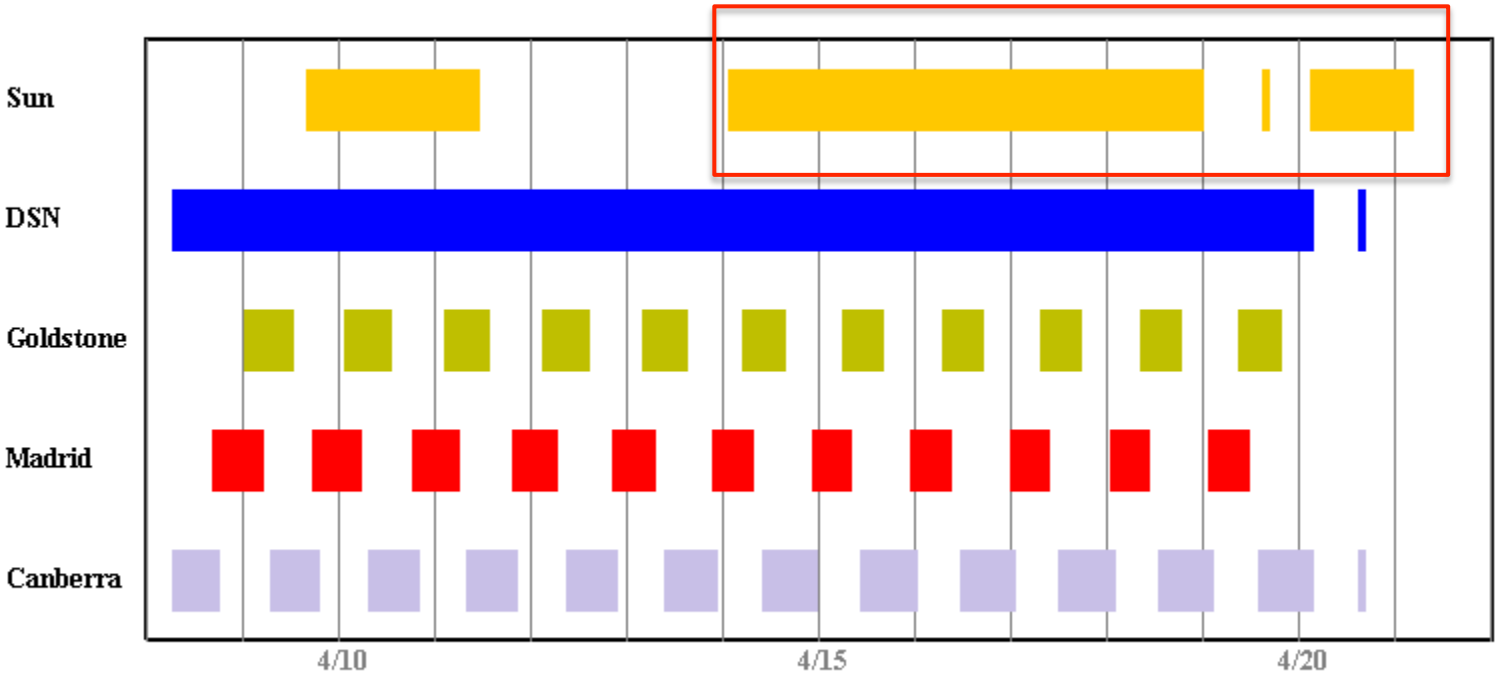
# *Numbers for Mid-Summer to Mid Winter*

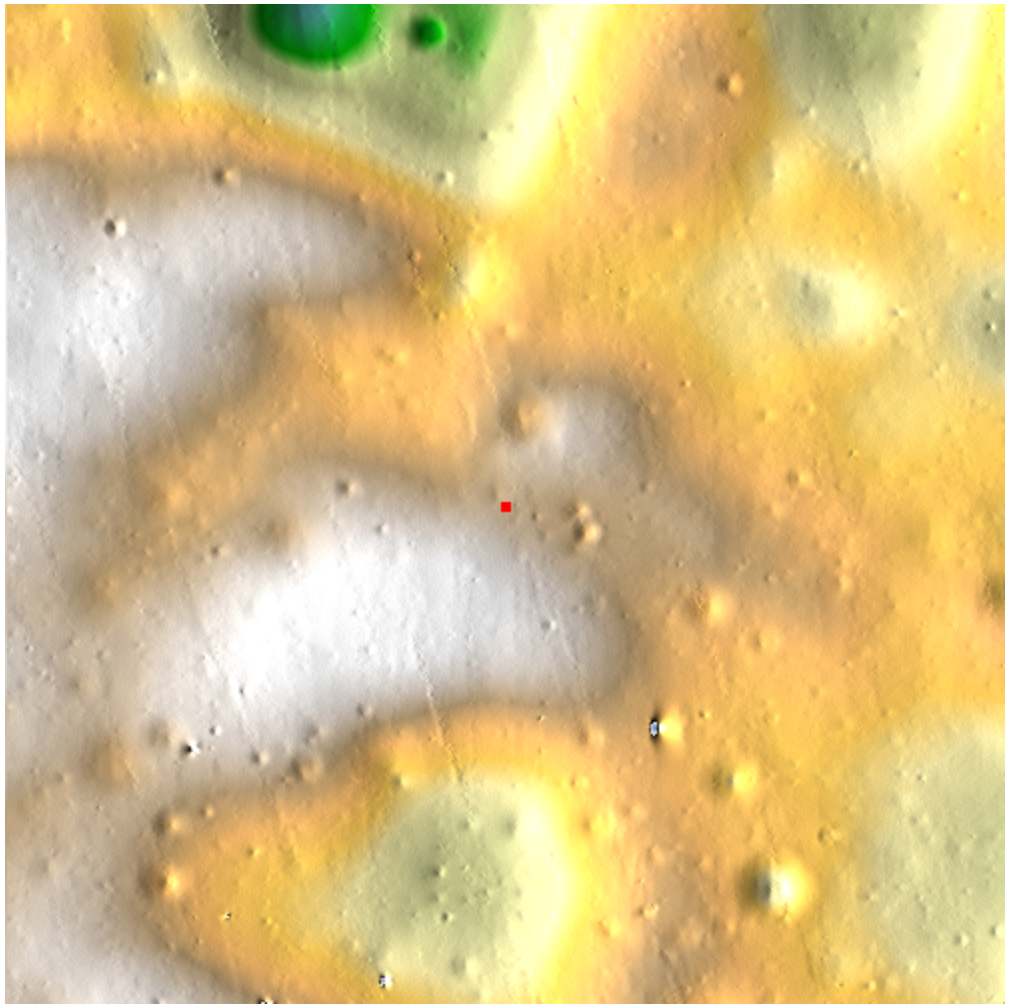
| Name | Mean Illumination | Longest Shadow (days) | Longest Sunlight (days) |
|---|---|---|---|
| Peary N | 85.75% | 7 | 94 |
| Peary S | 85.45% | 9 | 84 |
| Hermite | 84.75% | 11 | 76 |

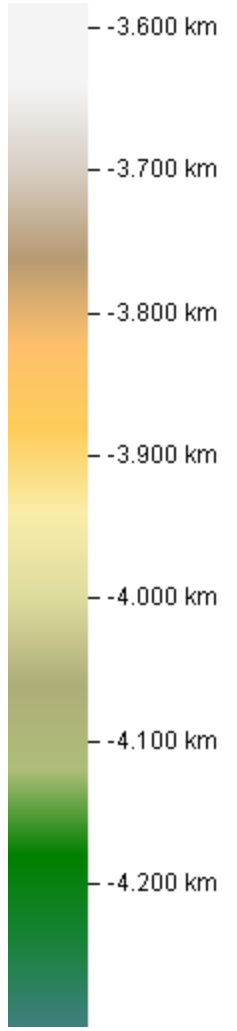
# Communications Analysis



# Oblique Stereographic Shaded Relief DTM Centered on A1
20 m/pix, 500x500 pixels (10 km x 10 km)

10 km





# 1 m Transmitter (A1), 1 m receiver
# Darkened areas do NOT have line of sight with transmitter

# 1 m Transmitter (A1), 2 m receiver
# Darkened areas do NOT have line of sight with transmitter

# 2 m Transmitter (A1), 1 m receiver
# Darkened areas do NOT have line of sight with transmitter

# 2 m Transmitter (A1), 2 m receiver
# Darkened areas do NOT have line of sight with transmitter

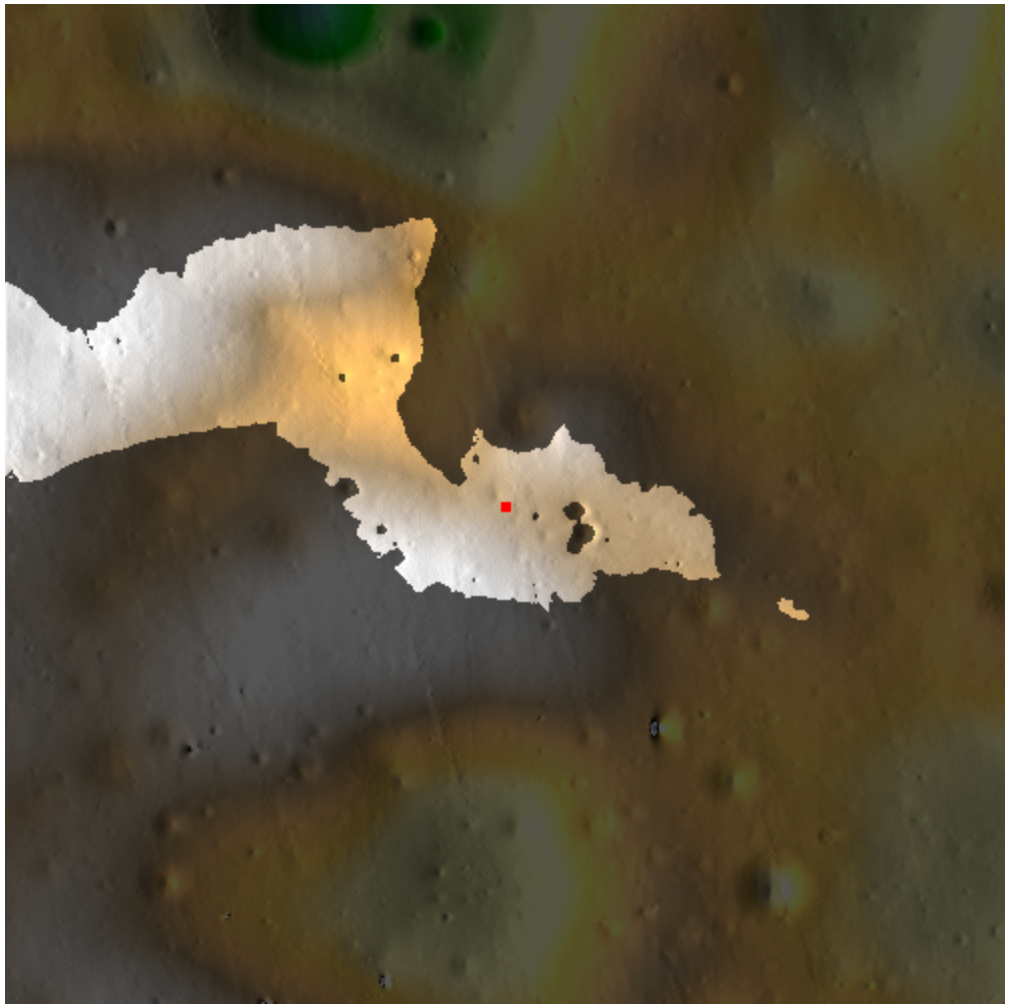
# 3 m Transmitter (A1), 1 m receiver
# Darkened areas do NOT have line of sight with transmitter

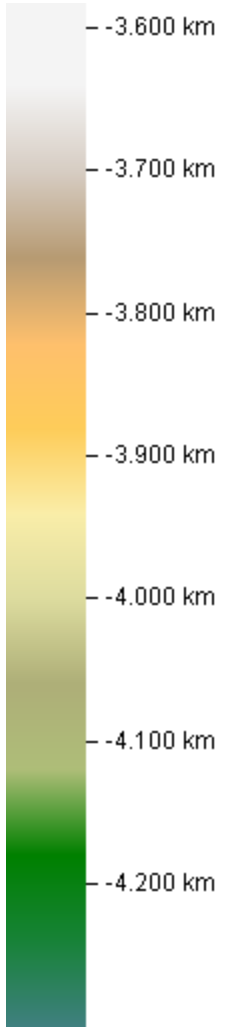
# 3 m Transmitter (A1), 2 m receiver
# Darkened areas do NOT have line of sight with transmitter

# 5 m Transmitter (A1), 3 m receiver
# Darkened areas do NOT have line of sight with transmitter

# 10 m Transmitter (A1), 3 m receiver
# Darkened areas do NOT have line of sight with transmitter

10 km





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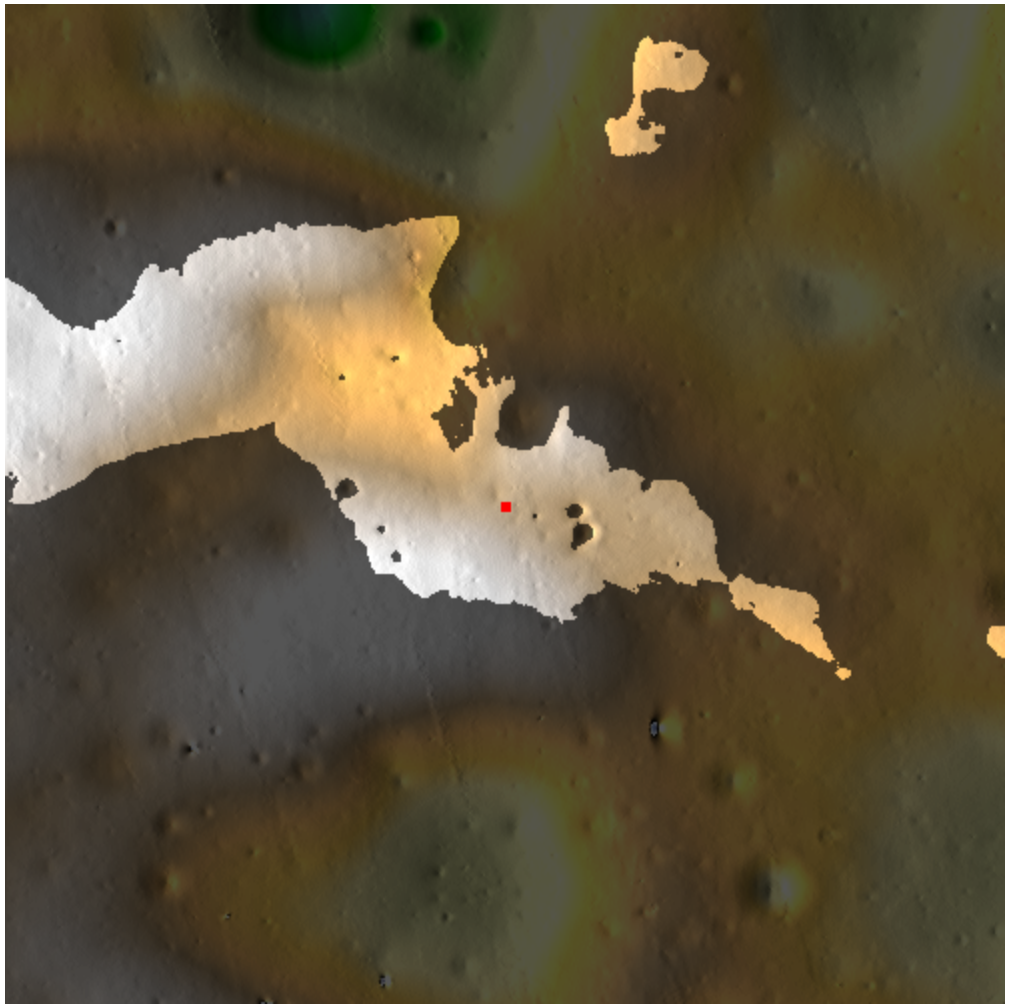
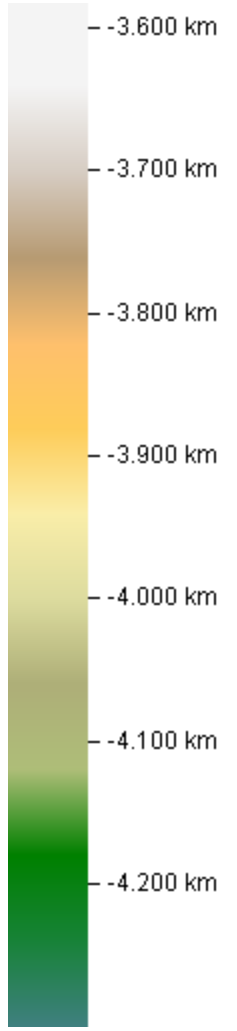
# 25 m Transmitter (A1), 3 m receiver
# Darkened areas do NOT have line of sight with transmitter

10 km





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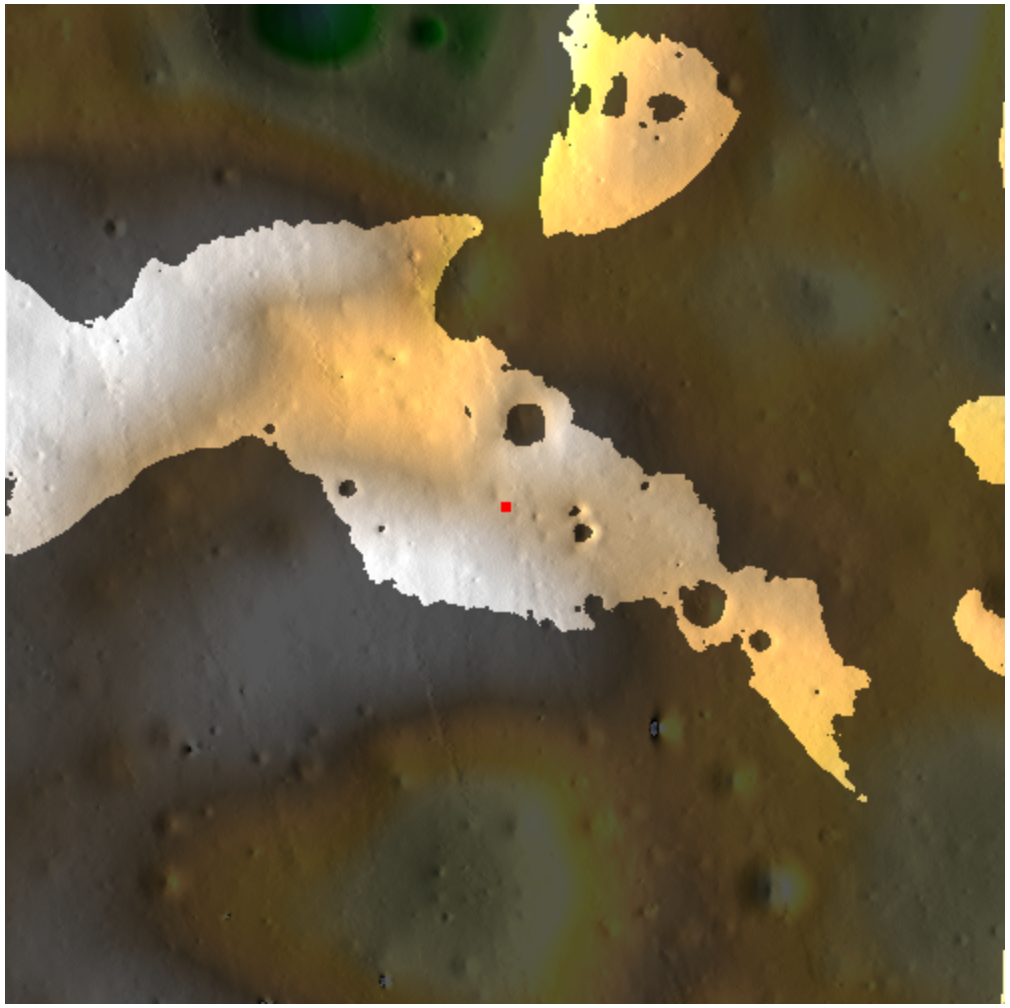
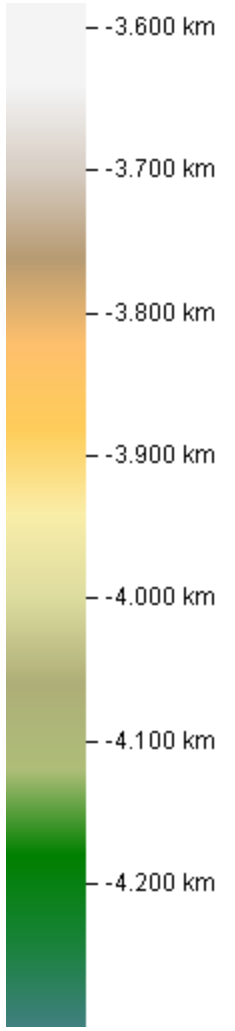
# 50 m Transmitter (A1), 3 m receiver
# Darkened areas do NOT have line of sight with transmitter

10 km





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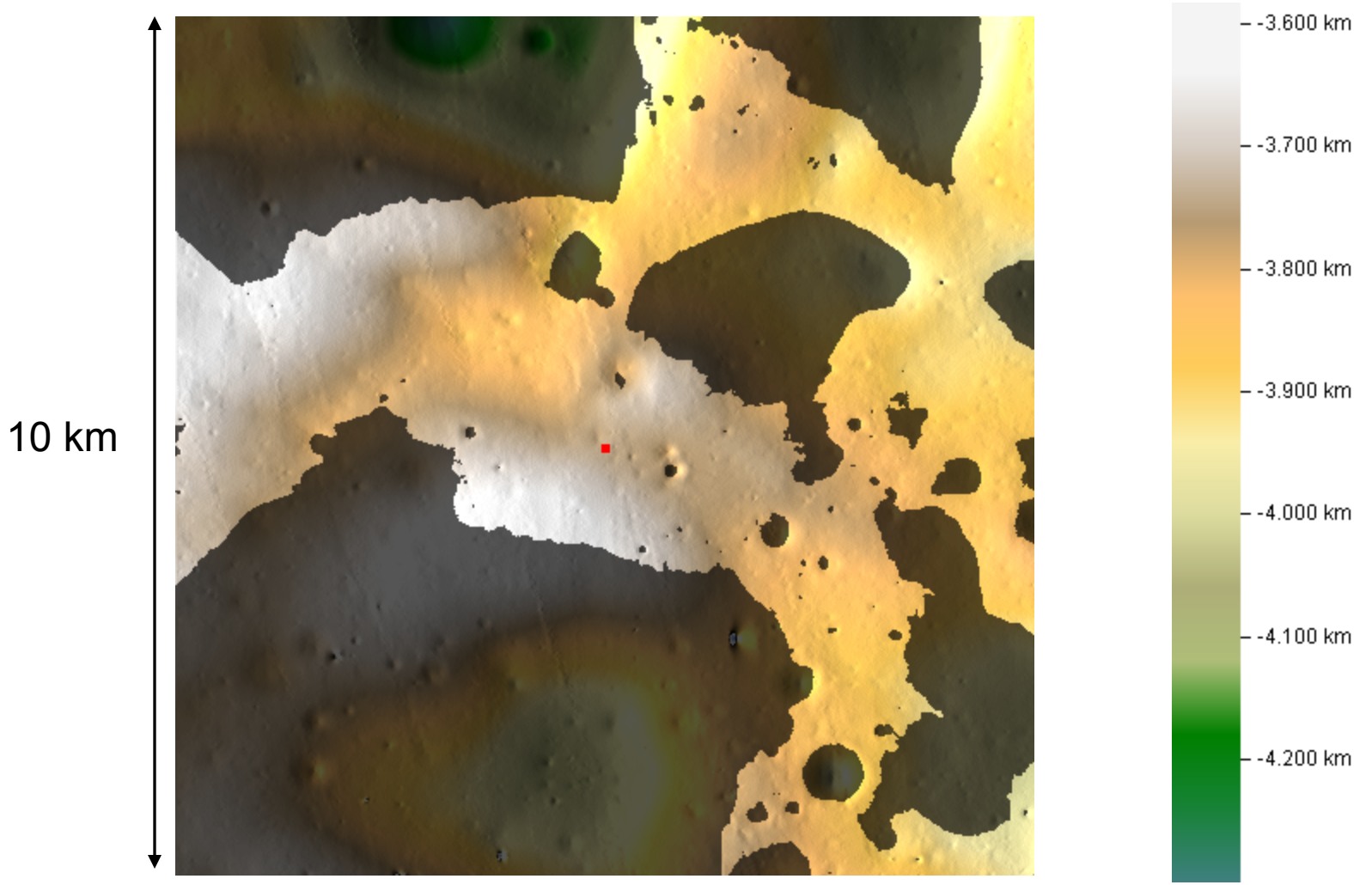
# 100 m Transmitter (A1), 3 m receiver
# Darkened areas do NOT have line of sight with transmitter



# Conclusions

- North polar region represents an ideal future exploration site.
- Several sites offer multiple months of continuous sunlight around mid summer as well as relatively short shadowed periods.
- These locations are close to multiple areas of permanent shadow.
- Potential for lander/rover combination that enables exploration of permanently shadowed regions.